Amendment to the
Atlantic County, Cape May County , Lower Delaware and Tri-County Water Quality Management Plans

Seven Total Maximum Daily Loads for Total Coliform to Address Shellfish-Impaired Waters in Watershed Management Area 17 Lower Delaware Water Region

Proposed: February 21, 2006
Established:
Approved:
Adopted:

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United States Environmental Protection Agency, Region 2

TABLE OF CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (NJDEP) developed the *2004 Integrated List of Waterbodies* addressing the overall water quality of the State's waters and, in Sublist 5, identifying impaired waterbodies for which Total Maximum Daily Loads (TMDLs) may be necessary. The *2004 Integrated List of Waterbodies* was adopted by the Department on October 4, 2004, (36 NJR 4543(a)) as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A. 58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). The *2004 Integrated List of Waterbodies* Sublist 5 identified fifteen waterbodies that are impaired with respect to total coliform in Watershed Management Area (WMA) 17. In that list, a waterbody was determined to be impaired if it does not fully support shellfish harvest in accordance with National Shellfish Sanitation Program (NSSP) criteria. Portions of some waterbodies that were initially listed as impaired on the *2004 Integrated List of Waterbodies* Sublist 5 were subsequently determined through this study to be ineligible for development of a TMDL. There was insufficient or no data to develop a TMDL for some waterbodies. Where data was insufficient to develop a TMDL, the waterbodies will remain on Sublist 5. Where there was no data, the waterbody will be placed on Sublist 3 in the 2006 Integrated List. In addition, based on a spatial analysis of monitoring station locations and best available data, some of these waterbodies were found to be closed according to administrative requirements and not because of water quality data. Closures of waters as the result of administrative precautions will be removed from Sublist 5 in the 2006 Integrated List of Waterbodies. TMDLs were developed for the shellfish impaired waterbodies that were impaired because of water quality, as listed in Table 1. During the TMDL assessment process, the sampling sites encompassed within each impaired waterbody spatial extent were reevaluated and data from all sites within the spatial extent, including historical data, were considered for TMDL development. The more inclusive sampling site information for the waterbodies is included under "Site IDs Addressed" in Table 1. Some of the waterbodies were divided into smaller sub-groups that reflect more consistent local water quality conditions, watershed characteristics, and local pollution sources.

Table 1. Waterbodies in WMA 17 identified on the *2004 Integrated List of Waterbodies* as impaired for shellfishing

Waterbody	2004 303(d) Listing	Action
Alloway Creek Estuary	Alloway Creek Estuary	Unable to assess for TMDL
Beck Creek Estuary	3801D-I	TMDL Assessment - No Reduction
Canton Drain Estuary	Canton Drain Estuary	Unable to assess for TMDL
Cedar Creek Estuary-17	3805C, 3805J, 3805L, 3805M	TMDL Assessment - Reduction

Cohansey River Estuary	Cohansey River Estuary	TMDL Assessment - Reduction
Delaware Bay	Cherry Tree Ck to Artificial Island-2, 3, 4; Cohansey Cove-6; Back Ck-7; Dyer Cove-8; Delaware Bay Inshore-10; Lower Maurice R-11; Dennis Ck-12; Delaware Bay East-14, 15	TMDL Assessment - Reduction
Delaware Bay Tribs-Tidal	3841I-M, 3860B/C. 3862C/D, 3884C/D	TMDL Assessment - No Reduction
Dividing Creek Estuary	3840B, 3840C, 3840D, 3840E, 3840F, R44	TMDL Assessment – No Reduction Grouped with Delaware Bay Tribs-Tidal
Fortescue Creek Estuary	3840L, 3862E, 3862G, 3862H, 3841K, 3841L, 3841M	TMDL Assessment – No Reduction Grouped with Delaware Bay Tribs-Tidal
Maurice River Estuary and Cove	3847,3847A,3847B,3847C,3847D, 3848,3848A, 3848B,3848C,3900A,3900D,3900G,3900H,3900I, 3900J, 3900L,3900M	TMDL Assessment - Reduction
Middle Marsh Creek Estuary	4101E	TMDL Assessment - Reduction
Nantuxent Creek Estuary	3804L, 3408P	TMDL Assessment - Reduction
Oranoaken Creek Estuary	3867F, 3867J	TMDL Assessment - Reduction
Straight Creek Estuary	3869A	TMDL Assessment - No Reduction
The Glades	3840K	TMDL Assessment – No Reduction Grouped with Delaware Bay Tribs-Tidal

Nonpoint and stormwater point sources are the primary sources of total coliform loads in these waterbodies. Source loads were estimated for land uses in each watershed and for local marinas that may be causing water quality impacts in these waterbodies. Traditional point sources, i.e., treatment facilities that have a sanitary waste component, were considered de minimus, due to the use of effective disinfection practices by these facilities. TMDLs were developed based on an analysis of the existing pathogen indicator data compared to National Shellfish Sanitation Program (NSSP) and NJDEP pathogen indicator criteria, and the loading capacity has been allocated among the point and nonpoint sources. This TMDL report includes implementation strategies that will bring the subject waterbodies into compliance with the NSSP criteria for unrestricted shellfish harvest.

This report proposes seven TMDLs as amendments to the appropriate areawide water quality management plans in accordance with N.J.A.C. 7:15-3.4(g). This report was developed consistent with the United States Environmental Protection Agency's (USEPA's) May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs. Upon approval by EPA, these TMDLs will be adopted

as amendments to the Atlantic County, Tri-County and Lower Delaware Water Quality Management Plans in accordance with N.J.A.C. 7:15-3.4 (g).

1.0 INTRODUCTION

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet water quality standards after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The *Integrated List of Waterbodies* combines these two assessments and assigns waterbodies to one of five sublists. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required. In WMA 17, the *2004 Integrated List of Waterbodies* currently identifies fifteen waterbodies as impaired because they do not fully support shellfish use. In the course of developing TMDLs for the listed impairments, it was determined that portions of the waterbodies that were initially listed as impaired on the *2004 Integrated List of Waterbodies* Sublist 5 were subsequently determined to be ineligible for development of a TMDL. There was insufficient or no data to develop a TMDL for some waterbodies. Where data was insufficient to develop a TMDL, the waterbodies will remain on Sublist 5. Where there was no data, the waterbody will be placed on Sublist 3 in the 2006 Integrated List. In addition, based on a spatial analysis of monitoring station locations and best available data, some of the site identifications were found to be closed as the result of considering administrative requirements and not because of water quality data. Proximity to potential sources such as marinas, development served by septic systems and concentrated stormwater outfall locations warrants precautionary closures of shellfish waters on a seasonal or full time basis. Closures of waters for shellfishing as the result of administrative precautions will be removed from Sublist 5 in the 2006 Integrated List of Waterbodies. TMDLs were developed for the shellfish impaired waterbodies that were impaired because of water quality.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a waterbody can assimilate and still conform to applicable water quality standards and support designated uses. The TMDL or loading capacity is allocated to known point and nonpoint sources in the form of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

Recent EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. These TMDLs address the following required items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.
4. Load allocations.
5. Wasteload allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.

This report establishes seven TMDLs for total coliform to address the impaired shellfish waters in WMA 17. All of the impaired waterbodies were assigned a High priority ranking in the *2004 Integrated List of Waterbodies* Sublist 5. These TMDLs include management approaches to reduce pathogen contributions from various sources in order to attain applicable surface water quality standards and fully support the designated shellfish use. These TMDLs cover more area than is actually listed as being impaired due to the fact that the implementation plans, as described in detail later in this document, cover entire watersheds, not just the impaired waterbodies. These waterbodies will be moved to Sublist 4 following approval of the TMDLs by USEPA. In addition to the shellfish impairments, Dividing Creek Estuary was also listed as impaired for low dissolved oxygen on the 2004 *Integrated List*. This waterbody will remain on Sublist 5 for the remaining pollutant, which will be addressed in future TMDL efforts.

2.0 POLLUTANT OF CONCERN AND AREA OF INTEREST

The pollutant of concern for the proposed TMDLs is total coliform, which is measured as an indicator for the presence of pathogens. The National Shellfish Sanitation Program (NSSP) has established criteria for indicator organisms that are used to determine support of the shellfishing use. The NSSP sets forth other requirements for restricting shellfish harvest based on shoreline surveys. Where potential sources, such as wastewater or stormwater outfalls, septic systems or marinas, are present, precautionary restrictions are applied. These shellfish restrictions are referred to as administrative closures and are not appropriate for TMDL development. As discussed, where portions of listed impaired waterbodies were found to be administratively closed, they will be properly placed on Sublists 1 or 3 on the

2006 Integrated List. TMDLs were developed for the waterbodies listed in Table 2 and shown in Figure 1. As an aid to analysis, some waterbodies were divided into smaller sub-groups to reflect local water quality conditions, watershed characteristics, and local pollution sources. Sub-groups were delineated based on several criteria including the location of monitoring stations and data availability, the size and spatial extent of each waterbody, the location of possible pathogen sources, and other waterbody/watershed characteristics. A TMDL calculation was made for each waterbody sub-group or the entire waterbody if there were no sub-groups delineated. Waterbody sub-groups are listed in Table 2 and shown in Figure 1. The 2004 New Jersey 303(d) impairment listing for each waterbody (Sublist 5) is also provided in Table 2 for reference.

Table 2. Waterbodies listed for total coliform impairment in WMA 17

Waterbody	2004 303(d) Listing Site IDs	TMDL Site ID	Subgroup	Percent reduction
Beck Creek Estuary	3801D-I	3801D, 3801E, 3801F, 3801G, 3801H, 3801I	-	0%
Cedar Creek Estuary-17	3805C, 3805J, 3805L, 3805M	3805C, 3805G, 3805H, 3805I, 3805J, 3805L, 3805M, 3805D, 3805E, 3805F, 3805N	-	22%
Cohansey River Estuary	Cohansey River Estuary	4300C, 4300D, 4300E, 4300F, 4300G, 4300H, 4300I, 4300A, 4300B	-	72%
Delaware Bay	Cherry Tree Ck to Artificial Island-2, 3, 4; Cohansey Cove-6; Back Ck-7; Dyer Cove-8; Delaware Bay Inshore-10; Lower Maurice R-11; Dennis Ck-12; Delaware Bay East-14, 15	Delaware Bay-2, 3, 4	A	0%
		Delaware Bay-6	B	13%
		Delaware Bay-7	C	0%
		Delaware Bay-8	D	0%
		Delaware Bay-10	E	0%
		Delaware Bay-11, 15, 3884C, 3884D	F	77%
		Delaware Bay-14	G	0%
		Delaware Bay-12 **Dennis Creek Estuary** 3888J, 3888M, 38880-T, 3888V **Savages Run Estuary** 3888K **West Creek Estuary** 1887C, 1887D	H	0%
Delaware Bay Tribs-Tidal	3841I-M, 3860B/C, 3862C/D, 3884C/D	3840B-M, 3841J, 3841I, R44 **Dividing Creek Estuary** 3840B, 3840C, 3840D, 3840E, 3840F, R44 **The Glades** 3840K	A	0%
		3841C-H, 3841K-M, 3860B-C, 3862C **Fortescue Creek Estuary** 3840L, 3862E, 3862G, 3862H, 3841K, 3841L, 3841M	B	0%
Maurice River Estuary and Cove	3847, 3847A, 3847B, 3847C, 3847D, 3848, 3848A, 3848B,	3900A, 3900D, 3900G, 3900H, 3900J, 3900I, 3900L, 3900M	-	78%

Waterbody	2004 303(d) Listing Site IDs	TMDL Site ID	Subgroup	Percent reduction
	3848C, 3900A, 3900D, 3900G, 3900H, 3900I, 3900J, 3900L, 3900M			
Middle Marsh Creek Estuary	4101E	4101E, 4101F	-	22%
Nantuxent Creek Estuary	3804L, 3408P	3804L, 3804N, 3804P	-	46%
Oranoaken Creek Estuary	3867F, 3867J	3867F, 3867J, 3867G, 3867H, 3867I, 3867K	-	47%
Straight Creek Estuary	3869A	3869A-E	-	0%

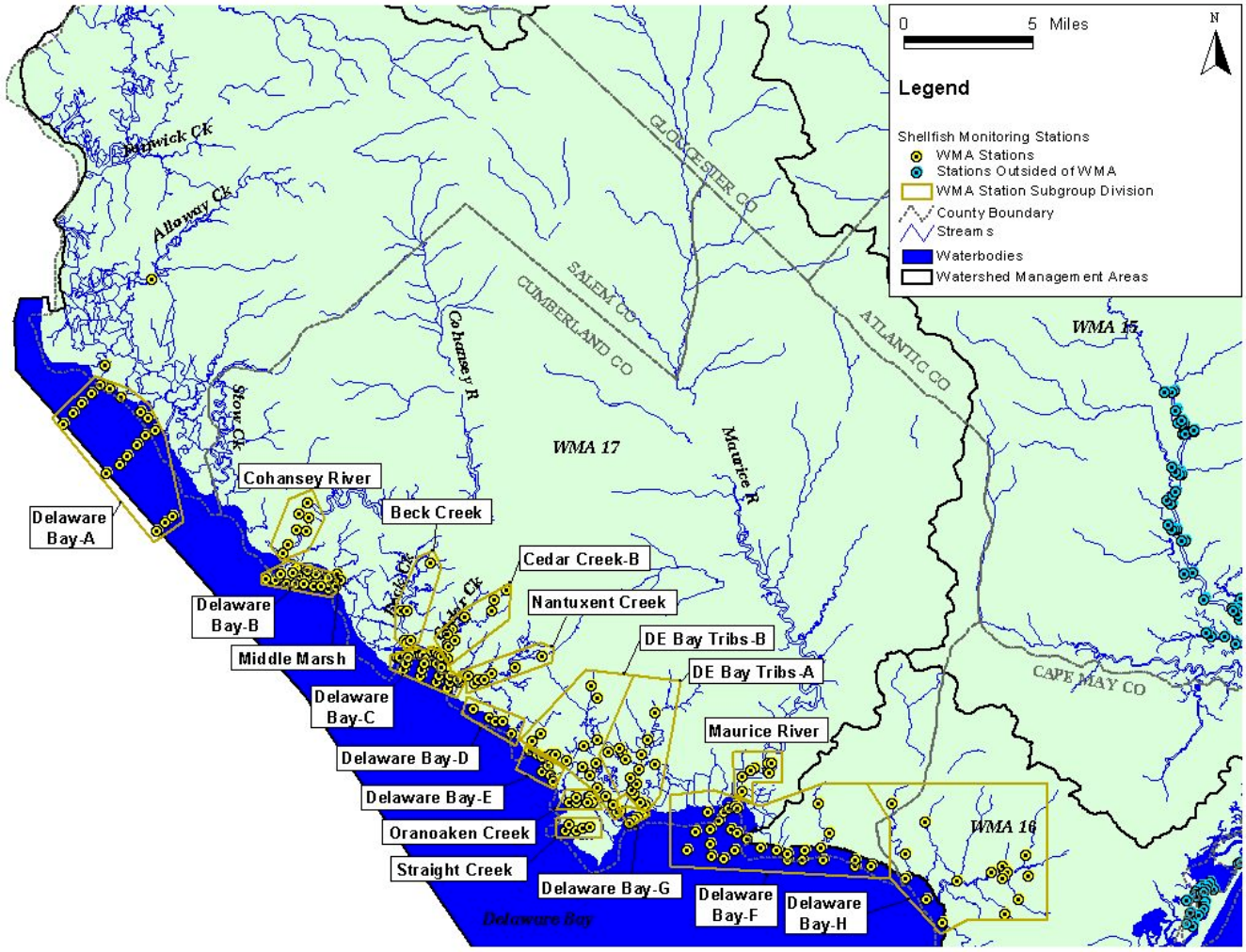

Figure 1. Shellfish impaired waterbodies in WMA 17

2.1 Applicable Water Quality Standards

New Jersey Surface Water Quality Standards (SWQS) include pathogen indicator criteria for the assessment of the recreational use (primary and secondary contact recreation) for all waterbodies (Table 3). New Jersey SWQS also specify that shellfish waters shall meet the guidelines of the National Shellfish Sanitation Program (NSSP). The NSSP guidelines include stringent criteria, expressed in terms of indicator organisms, to protect against the harvest of shellfish in waters where the sanitary quality could have health risks for consumers. Total coliform data are used to assess the shellfish designated use for the waterbodies in all waters according to the New Jersey *2004 Integrated Water Quality Monitoring and Assessment Report*. With the exception of ocean waters, samples were collected using the Systematic Random Sampling (SRS) protocol. Ocean waters were collected using the Adverse Pollution Condition (APC) protocol. The analytical methods used were 3-tube dilution analysis for total coliform and 5-tube analysis for fecal coliform. These TMDLs were developed to meet the NSSP 90th percentile (330 cfu/100ml) and geometric mean (70 cfu/100ml) criteria for total coliform (in colony forming units, or cfu) because this is the basis for determining impairment in the subject waters.

Table 3. Water quality criteria expressed in CFU/100 ml

Bacterial Indicator	NJ Surface Water Quality Standards (SWQS) *		National Shellfish Sanitation Program (NSSP)
	Within 1500 ft. of shoreline	1500 ft. to 3 mi. from shoreline	
Total Coliform	N/A	N/A	• Geometric Mean (Geomean) shall not exceed 70 • No more than 10% of samples shall exceed 330 for APC monitoring • Estimated 90th percentile shall not exceed 330 for SRS monitoring
Fecal Coliform	• Geomean shall not exceed 50	• Geomean shall not exceed 200 • No more than 10% in any 30-day period to exceed 400	• Median or geomean shall not exceed 14 • No more than 10% shall exceed 49 for APC monitoring • Estimated 90th percentile shall not exceed 49 for SRS monitoring
Enterococcus	• Geomean shall not exceed 35 • Single sample shall not exceed 104	N/A	N/A

Source: NJDEP SWQS, 2005 and USFDA NSSP Guide for the Control of Molluscan Fish, 2003.

Notes:

- Samples shall be obtained at sufficient frequencies and at locations during periods which will permit valid interpretation of laboratory analyses. A minimum of five samples as equally spaced over a 30-day period, as feasible, should be collected; however, the number of samples, frequencies and locations will be determined by NJDEP or other appropriate agency in any particular case.
- NSSP standards shown are based on a 3-tube decimal dilution test. Additional standards for 5- and 12-tube decimal dilution tests apply.
- For NSSP sampling, sample collection requirements vary based on attributes of the waters where samples are collected (e.g., whether the area is affected by point sources, etc.).
- Standards shown are those that apply to waters approved for shellfish growing. Additional requirements and exceptions may apply and can be found in NJDEP's SWQS and NSSP's guidelines documents.

- APC = Adverse Pollution Conditions. APC sampling occurs in areas with known point sources, including around some marinas.
- SRS = Systematic Random Sampling. SRS sampling methods are used in the majority of shellfish waters and is based on a random statistical sampling approach.

Each year, the Department updates the classification of New Jersey's coastal waters for shellfish harvesting based on analysis of extensive sampling (over 15,000 samples per year) and pollution source surveys. The classifications indicate sanitary coastal water quality. New Jersey has had a long history of improving the sanitary quality of its coastal waters.

In accordance with the NSSP, the Department must also perform a sanitary survey/Local Area Report (LAR) that collects and evaluates information concerning actual and potential pollution sources that may adversely affect the water quality in each growing area. Based on the sanitary survey information, the Department assigns the growing area to one of five classifications. These classifications are summarized below.

Classification	**Description**
Approved	No restrictions on licensed harvesters
Seasonal (November - April)	Water open for harvest seasonally from Nov - April
Seasonal (January - April)	Water open for harvest seasonally from January - April
Special Restricted	Harvest only by Special Permit. Shellfish harvested must be further purified by relay to Approved waters or processing in a depuration plant prior to being sold.
Prohibited	No harvest under any conditions.

The impaired waterbodies addressed in this document are classified as Saline Estuary 1 (SE1), except for small portions in the upper reaches of tidal streams that are classified as Fresh Water 2 (FW2).

In all SE1 waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;
2. Maintenance, migration and propagation of the natural and established biota;
3. Primary and secondary contact recreation; and
4. Any other reasonable uses.

In all FW2 waters, the designated uses are (from NJAC 7:9B-1.12):

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and

5. Any other reasonable uses.

2.2 Description of Land Use in the Watershed Management Area

Watershed Management Area 17 includes the Cohansey, Maurice, and Salem Rivers and Alloway, Dividing, Manantico, Manusmuskin, Miles, Mill, Stow and Whooping Creeks. This is an area of very low relief, which results in numerous small, winding tributaries and wide expanses of wetlands. Agriculture and forest are the main land uses of the overall watershed. Table 4 shows the land use distribution among the waterbody subgroup watersheds. Land use data for each watershed were derived from the 1995/1997 land use/land cover dataset developed for New Jersey.

Table 4. Land use area distribution in WMA 17 subgroup watersheds

Waterbody	Subgroup	Agriculture		Barren Land		Forest		Urban		Water		Wetlands		Total Area
		km²	%	km²	%	km²	%	km²	%	km²	%	km²	%	km²
Beck Creek Estuary	-	8.13	18.1%	0.12	0.3%	1.93	4.3%	0.61	1.3%	3.90	8.7%	30.33	67.4%	45.02
Cedar Creek Estuary-17	B	7.03	19.9%	0.07	0.2%	10.18	28.8%	2.59	7.3%	1.02	2.9%	14.41	40.8%	35.31
Cohansey River Estuary	-	127.88	48.7%	1.71	0.7%	51.38	19.6%	37.43	14.3%	10.55	4.0%	33.53	12.8%	262.48
Delaware Bay	A	39.25	24.5%	0.58	0.4%	28.51	17.8%	7.74	4.8%	9.85	6.1%	74.41	46.4%	160.35
Delaware Bay	B	130.86	44.3%	1.79	0.6%	65.45	22.2%	38.39	13.0%	12.69	4.3%	45.93	15.6%	295.12
Delaware Bay	C	19.26	16.0%	0.32	0.3%	23.72	19.7%	4.36	3.6%	8.14	6.8%	64.75	53.7%	120.55
Delaware Bay	D	0.07	0.7%	0.21	2.0%	0.01	0.1%	0.12	1.2%	0.85	8.3%	8.99	87.8%	10.24
Delaware Bay	E	0.46	5.5%	0.06	0.7%	0.06	0.7%	0.44	5.4%	0.39	4.7%	6.85	83.0%	8.25
Delaware Bay	F	216.16	20.7%	11.68	1.1%	386.41	37.0%	169.98	16.3%	27.03	2.6%	232.30	22.3%	1043.54
Delaware Bay	G	2.76	2.6%	2.11	2.0%	18.12	16.9%	2.24	2.1%	13.12	12.2%	68.88	64.2%	107.25
Delaware Bay	H	9.76	5.1%	1.47	0.8%	64.09	33.8%	11.27	5.9%	4.67	2.5%	98.56	51.9%	189.82
Delaware Bay Tribs-Tidal	B	1.53	3.5%	0.13	0.3%	2.18	4.9%	1.02	2.3%	5.45	12.3%	33.85	76.7%	44.16
Delaware Bay Tribs-Tidal (Fortescue Creek Estuary)	A	1.69	2.4%	2.04	2.9%	16.00	22.4%	1.67	2.3%	8.07	11.3%	41.88	58.7%	71.34
Maurice River Estuary and Cove	-	214.00	21.5%	11.27	1.1%	383.42	38.5%	168.27	16.9%	24.52	2.5%	193.37	19.4%	994.84
Middle Marsh Creek Estuary	-	1.18	8.5%	0.07	0.5%	0.76	5.4%	0.07	0.5%	1.99	14.3%	9.88	70.8%	13.94
Nantuxent Creek Estuary	-	4.10	10.2%	0.13	0.3%	11.61	28.9%	1.17	2.9%	3.21	8.0%	20.00	49.7%	40.22
Oranoaken Creek Estuary	-	0.00	0.0%	0.03	0.5%	0.00	0.0%	0.01	0.2%	0.48	8.9%	4.88	90.4%	5.40
Straight Creek Estuary	-	0.00	0.0%	0.03	0.6%	0.00	0.0%	0.00	0.0%	0.75	18.2%	3.32	81.1%	4.09

3.0 SOURCE ASSESSMENT

A source assessment was conducted to identify and characterize potential pathogen sources that may be impacting water quality and shellfish growing areas in the listed waters. Point and nonpoint sources were considered in TMDL development. Source assessment also included the determination of the relative contribution of the primary bacteria sources to facilitate proper management responses through TMDL implementation. A variety of information was used to characterize possible pathogen sources including shoreline surveys conducted by the Department, land use information gathered for each watershed, point source information, literature sources, and other available data.

3.1 Shoreline Surveys

WMA 17 includes one shoreline survey area: Delaware Bay (DB-1). This shellfish area includes the upper portion of Delaware Bay from East Point to Artificial Island. Major tributaries include Maurice River, Nantuxent Creek, Cohansey River, Stow Creek, and Mad Horse Creek. Cumberland and Salem counties are located along this shoreline. Shellfish growing areas are classified as Approved, Seasonally Approved, and Special Restricted in this area (2004).

3.2 Assessment of Point Sources

For TMDL development purposes, point sources include domestic and industrial wastewater treatment plants that discharge to surface waters, as well as surface water discharges of stormwater subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits, Tier A municipalities, and federal, interstate agency, state, and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Tier A municipalities are generally located within the more densely populated regions of the state or along the coast. These municipalities meet the population size requirements of EPA's Municipal Separate Storm Sewer System (MS4) program for regulating urban stormwater discharges. Stormwater point sources, like nonpoint sources, derive their pollutant loads from runoff from land surfaces and load reduction is accomplished through the use of best management practices (BMPs). The distinction is that stormwater point sources are regulated under the Clean Water Act (under the MS4 program). Stormwater point sources are or will be addressed through the management practices required through the discharge permits.

Wastewater treatment facilities and Tier A municipalities that directly discharge to the shellfish waters in WMA 17 or tributaries that eventually flow into these waters are identified in Appendices B and C. Per Department NJPDES Regulation, N.J.A.C. 7:14A-12.5(a), "All wastewater that could contain pathogenic organisms such as fecal coliform and/or enterococci organisms shall be subject to continuous year round disinfection prior to discharge into surface waters." Therefore, loads from wastewater treatment facilities were

considered de minimus, consistent with previous pathogen TMDLs developed by the Department. The NJPDES permit limits for these point sources will not be changed as a result of these TMDLs. Stormwater loads from Tier A MS4 systems are point sources that can be significant. These loads were estimated using the watershed loading methods described in the nonpoint source section.

3.3 Assessment of Nonpoint Sources

Nonpoint sources that may affect shellfish waters include stormwater discharges that are not subject to regulation under the Clean Water Act, including Tier B municipalities, direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. Tier B municipalities are generally located in more rural, non-coastal regions of the state. Tier B municipalities located in the affected drainage areas are identified in Appendix C.

Alternative methods were considered to determine the best approach for estimating land-based loads contributed by each watershed, including the Watershed Treatment Model (WTM) a study of nonpoint source loadings generated in a study of the Toms River watershed, and simpler bacteria load estimation equations. The WTM model was selected because it encompasses local rainfall data and stream length information to better tailor load estimates. In addition, it has been successfully applied in previous coastal TMDL studies (Oyster Bay-New York, U.S. Virgin Islands TMDLs). The goal of applying WTM is to characterize all the point and nonpoint sources, as available data allows, in the existing system and to determine their relative contributions to the waterbody of interest. The loading values thus derived, along with the loads contributed by marinas as discussed below, serve as the reference point from which reductions are made to meet TMDL targets.

The WTM model is a series of spreadsheets that quantifies the loading of pathogen indicators based on land use distribution, stream network length in the watershed, and annual rainfall. The model is designed as a planning level tool for watersheds that do not have sufficient data for complex modeling applications. Although the WTM model has several tiers of data specificity, loading estimates can be calculated with simple land use data, as they were for these shellfish TMDLs. Land use loads are calculated on an annual basis by using a series of coefficients for runoff volume and pathogen loading derived from scientific literature. General land use categories are assigned either a coefficient that is then multiplied by an annual runoff volume to calculate an annual load (e.g., urban land uses), or an annual unit area load that is applied as a function of land use (e.g., rural land uses). These coefficients, presented in Table 5, were chosen based upon the best available research and are summarized in WTM's user manual (Caraco, 2001).

Table 5. Default WTM land use categories and loading variables

WTM Land Use	Corresponding New Jersey Land Uses	Average % Impervious Cover	Fecal Coliform Conc. (MPN/100 ml) or Annual Load (billion/acre)

WTM Land Use	Corresponding New Jersey Land Uses	Average % Impervious Cover	Fecal Coliform Conc. (MPN/100 ml) or Annual Load (billion/acre)
Low Density Residential	Low Density Residential, Rural Residential, Recreational Land, Athletic Fields	19	20,000
Medium Density Residential	Medium Density Residential, Mixed Residential, Mixed Urban or Built-Up, Other Urban or Built-Up, Military Reservations, No Longer Military	35	20,000
High Density Residential	High Density Residential	56	20,000
Commercial	Commercial Services	71	20,000
Roadway	Transportation/Communication/Utilities	39	20,000
Industrial	Industrial, Industrial/Commercial	78	20,000
Forest	Forest	0	Load: 12 billion/acre
Rural	Agriculture	0	Load: 39 billion/acre
Barren (replaced "Vacant Lots" category in WTM)	Barren	2	Load: 12 billion/acre (estimated)

The default fecal coliform loading rates in the WTM model were converted to total coliform values based on a regression equation developed to examine the relationship between fecal coliform and total coliform concentrations using shellfish monitoring data collected from 1991 through 2004. Fecal coliform is a component of total coliform, therefore, the loading values were increased based on this equation.

The potential to accurately convert observed fecal coliform values to equivalent total coliform values is supported by a November 1996 study by Espy, Huston, and Associates, Inc. This study investigated public health issues related to recreational and commercial fisheries use of Corpus Christi Bay, Texas produced for the Corpus Christi Bay National Estuary Program (Jensen et al., 1996). A significant correlation (R^2=85.7%) was found between total and fecal coliform concentrations reported for water samples collected in shared sampling quadrants when plotted on a logarithmic scale. The regression equation derived from the Texas data, converted into an exponential expression ($TC=1.69*FC^{1.013}$) is very similar to the equation derived from water quality data analyzed as part of these TMDLs ($TC=1.22*FC^{1.061}$).

The watershed for each TMDL waterbody sub-group was delineated using the Hydrologic Unit Coverage (HUC-14 digit) developed by NJDEP, digital elevation model (DEM) data, and the National Hydrography Dataset (NHD) stream coverage for New Jersey. Land use data for each watershed was obtained from the 1995/1997 land use coverage developed for New Jersey's WMAs. Land use categories were consolidated into broader groups for use in estimating land-based loads using the WTM model and for presenting the loading results. The percent impervious information for each land use category was derived from the percent impervious information in the Department's GIS land use coverage, averaged across similar land uses. The bacterial loads for urban areas in each watershed were calculated based on the default fecal coliform concentration literature value for urban land uses, the average percent impervious cover, and the annual runoff volume calculated by the WM model.

Agricultural, forest, and barren land use loads were calculated based on the specific loading rate for each category. Wetland areas and waterways were not included in loading calculations based on WTM model assumptions.

In addition to land-based sources, pathogens can also be associated with direct discharges from boats at marinas. This potential source can be a primary cause of high bacteria concentrations in and around marinas. The bacteria load from inappropriate and illicit wastewater discharges in marinas and mooring locations was estimated based on the marina GIS coverage provided by NJDEP. This dataset includes information on the number of boat slips and boat sizes typical of each marina. The marina formula presented in the Department's shoreline surveys (LARs) was used to calculate the bacteria load for each marina. Marina loads were calculated for the summer months (May – September). In addition, marina loads were multiplied by a factor of 0.25 to recognize a lower contribution during other months (October through April) based on best professional judgment. The marina formula was updated to calculate total coliform loads based on the total coliform-fecal coliform regression equation developed for this TMDL study, as described in the WTM model discussion above. Marinas associated with each waterbody (or sub-group) and the calculated total coliform/fecal coliform loads are presented in Appendix D.

The equation used to estimate coliform loads from marina buffers is:

$$FC\,/\,day = 2x10^{9}(FC\,/\,person/\,day)x2(person/boat)x[(.25slips \geq 24') + (0.065 \times slips < 24')]$$

Explanation of terms in equation:

Fecal coliform per person per day:	2×10^{9}
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste

Direct contributions from illicit discharges, livestock, pets, and wildlife (e.g. seagulls, geese, and other waterfowl in particular) were not estimated based on the lack of site-specific information needed to represent these sources. Note that waterfowl direct deposition in some shellfish areas was mentioned as a likely source according to several published shoreline survey reports for New Jersey. Population estimates, bacteria production rates, and other information would be needed to estimate the relative impact of these sources. Determining the relative importance of this source will be a component of the implementation plan, in order to determine the importance of focusing management strategies to address these sources. Therefore, loads from failing systems, discharges from malfunctioning sewer conveyances, and bacteria loads contributed by livestock, pets, and wildlife in each watershed were assumed to be included in the land use loading coefficients.

Pathogen indicator source data used in TMDL development are shown in Figures 2 and 3. Land uses, NJPDES-permitted wastewater treatment facilities, marinas, stormwater outfalls, and water quality stations are shown in this map.

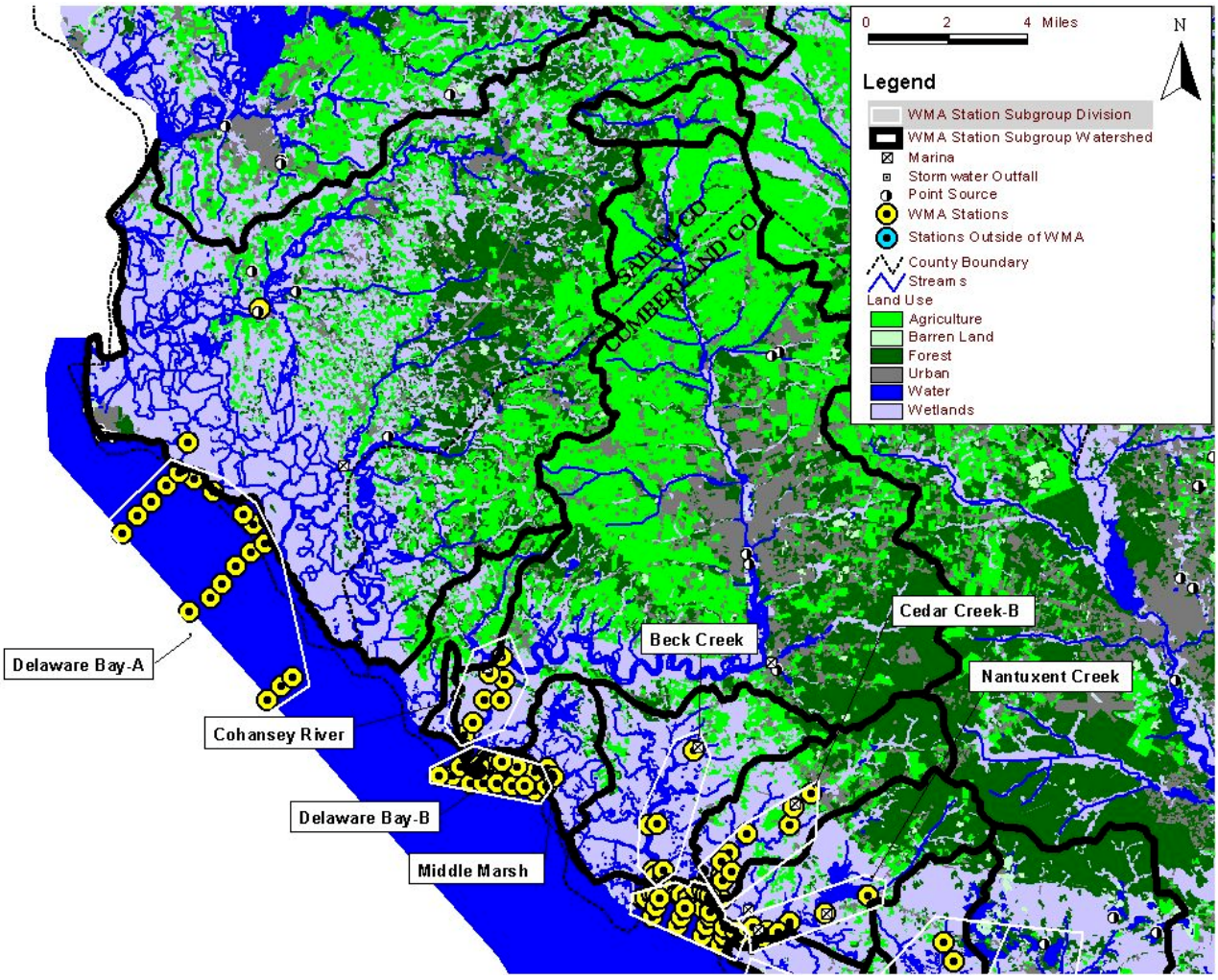

Figure 2. Primary bacteria source data used in TMDL development for western portions of WMA 17

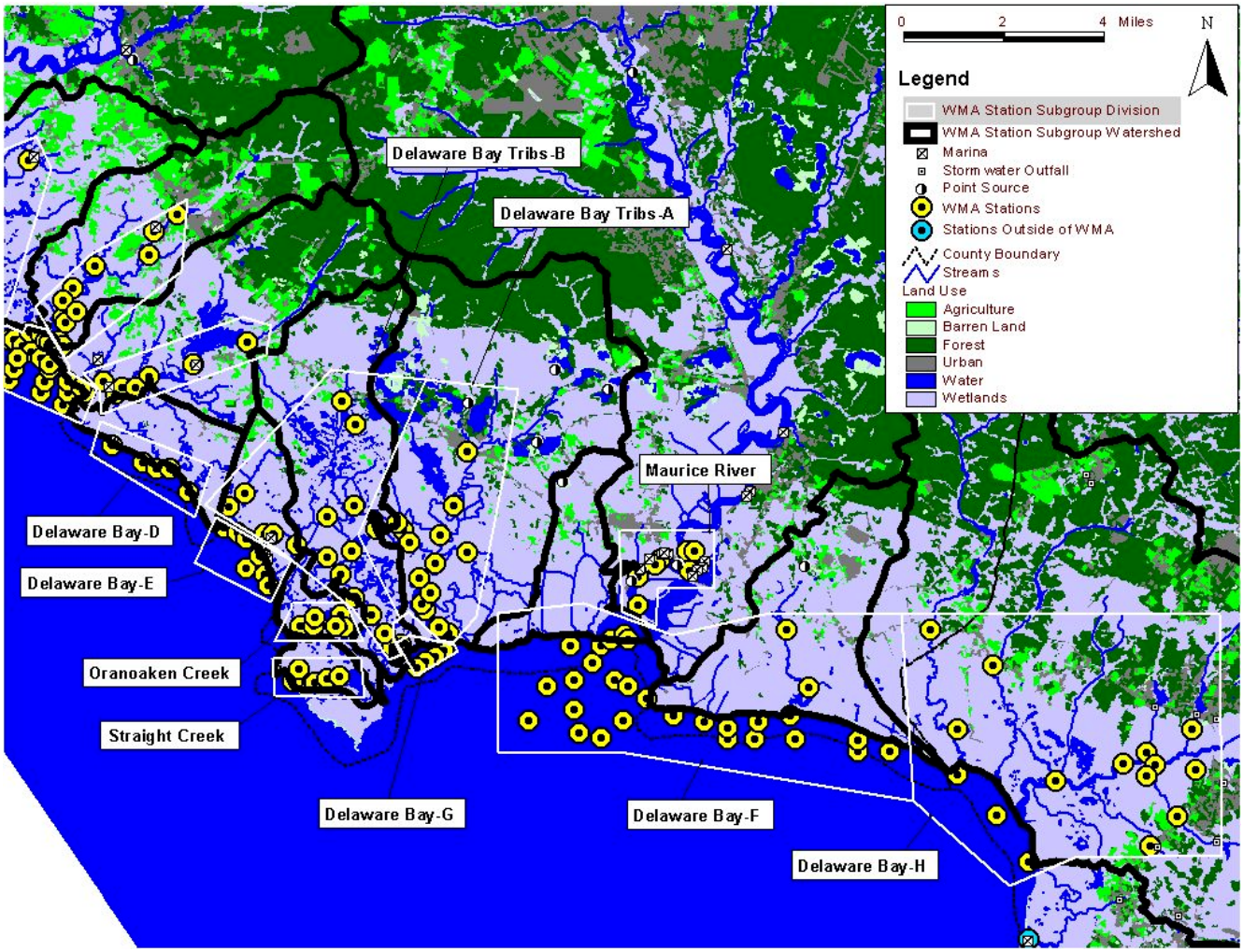

Figure 3. Primary bacteria source data used in TMDL development for eastern portions of WMA 17

4.0 WATER QUALITY ANALYSIS

Relating pathogen sources to concentrations of bacterial indicators in the impaired waters is distinguished from quantifying that relationship for other pollutants given the inherent variability in population size and dependence not only on physical factors such as temperature and soil characteristics, but also on less predictable factors such as re-growth media. Since bacteria loads and concentrations can vary many orders of magnitude over short distances and over time at a single location, dynamic water quality models can be very difficult to calibrate. Options available to control nonpoint sources of bacteria typically include measures such as sewage infrastructure improvements, goose management strategies, pet waste ordinances, agricultural conservation management plans, and septic system replacement and maintenance. The effectiveness of these control measures is not easily measured relative to observed ambient concentrations. Given these considerations, detailed water quality modeling was not selected for determining the load reductions needed to attain standards and support the designated shellfish use.

Shellfish monitoring data collected by the Department, in accordance with NSSP guidelines, were used as the basis for TMDL development for the listed shellfish waters. Total coliform data were used to assess the shellfish designated use for the listed waterbodies in WMA 17 according to the New Jersey 2004 *Integrated Water Quality Monitoring and Assessment Report*; therefore, total coliform data were used in TMDL development. As described in Section 3.0, each waterbody was divided into smaller sub-groups (as necessary) in order to better represent local water quality conditions, watershed characteristics, and local pollution sources and, thereby inform implementation efforts. The data collected for each waterbody sub-group (or the entire waterbody if not sub-divided) were compared to the NSSP criteria for total coliform. In order to account for the spatial distribution in pathogen sources, critical conditions, and other TMDL considerations, the "worst case" station within each waterbody (or sub-group) was identified and used in TMDL development. Monitoring data collected at stations located within marina buffer areas were not included in the analysis because these areas will remain restricted for shellfish harvest as a precautionary measure. Seasonal trends and other factors were evaluated to determine the critical condition period for TMDL development, as described in the next section. Critical condition analyses indicated that bacteria concentrations were typically higher during summer months, therefore, summer data (collected during May-September) were exclusively used in the analysis.

"Worst case" stations were identified based on the calculated 90th percentile (arithmetic), median, data period (emphasis on recent data), and sample size (priority given to stations with sample sizes >20). The "worst case" station identified for each waterbody (or sub-group) is shown in Table 6, along with summary data statistics. The data collected at each "worst case" station was then used to develop TMDLs for each respective waterbody (or sub-group). The percent reduction required was based on the difference between the calculated 90th percentile (using the FDA method specified in NSSP guidelines) and the NSSP 90th percentile criteria or the calculated geometric mean and the NSSP geometric mean criteria whichever was greater. Source loads were then reduced for each waterbody (or sub-group) to meet the overall percent reduction required.

As a result of this analysis, several waterbodies (or sub-groups) were found to meet the NSSP criteria. These waterbodies reflect application of the shoreline survey information in making water classifications. Critical to the shoreline survey is the identification of <u>potential</u> pollution sources that may intermittently impact water quality and not be detected by water samples collected 5-12 times a year. According to the NSSP *Guide for the Control of Molluscan Shellfish*, if in the judgment of the state authority, pollution sources present an actual <u>or</u> potential public health hazard, those waters cannot be classified as "Approved". Shellfish harvest restrictions that are imposed because of the shoreline surveys will remain restricted, regardless of water quality. Therefore, development of a TMDL for these areas is not generally appropriate. These areas will be reassigned on the 2006 Integrated List. In areas subject to administrative closure where water quality conforms to criteria, the areas will be placed on Sublist 1; where there is insufficient data to determine conformance with the criteria, the areas will be placed on Sublist 3; where the water quality does not conform to the criteria, but the areas would not be open even if water quality improved, the areas will be placed on Sublist 4.

Table 6. Worst case stations in WMA 17

Waterbody	Subgroup	Worst Case Station	Parameter	Count*	Start Date	End Date	90th Percentile* (arithmetic)	Geometric Mean*	Median*
Beck Creek Estuary	A	3801G	Total Coliform	34	6/20/89	8/22/03	240	39	43
Cedar Creek Estuary-17	B	3805F	Total Coliform	32	6/20/89	8/22/03	438	48	75
Cohansey River Estuary	-	4300E	Total Coliform	14	4/30/99	8/24/04	1100	123	122
Delaware Bay	A	4204D	Total Coliform	50	6/23/92	4/2/04	159	19	23
Delaware Bay	B	4100J	Total Coliform	71	6/4/84	3/30/04	460	50	43
Delaware Bay	C	3804E	Total Coliform	62	6/27/84	8/22/03	240	44	43
Delaware Bay	D	3858A	Total Coliform	63	6/21/85	3/26/04	139	13	9
Delaware Bay	E	3860A	Total Coliform	63	6/21/85	10/14/03	240	32	28
Delaware Bay	F	3848B	Total Coliform	41	2/9/84	10/20/03	1100	231	240
Delaware Bay	G	3840	Total Coliform	68	2/9/84	4/1/04	341	33	23
Delaware Bay	H	3887B	Total Coliform	79	6/26/84	10/7/03	93	13	9
Delaware Bay Tribs-Tidal (Fortescue Creek Estuary)	A	3840L	Total Coliform	21	2/9/84	10/20/03	460	32	23
Delaware Bay Tribs-Tidal	B	3841G	Total Coliform	24	2/9/84	4/1/04	358	32	23
Maurice River Estuary and Cove	-	3900A	Total Coliform	22	6/20/85	4/14/92	1100	239	240
Middle Marsh Creek Estuary	-	4101E	Total Coliform	37	6/4/84	4/9/92	328	71	75
Nantuxent Creek Estuary	-	3804F	Total Coliform	34	6/20/89	8/22/03	842	66	59
Oranoaken Creek Estuary	-	3867J	Total Coliform	42	10/1/86	7/1/04	460	83	93
Straight Creek Estuary	-	3869C	Total Coliform	58	6/21/85	10/14/03	460	42	43

* - Concentration expressed in cfu/100 ml
Green highlighted, worst case stations meet SWQS.

4.1 Seasonal Variation/Critical Conditions

The technical approach used to develop these TMDLs includes conservative assumptions that take into account seasonal variability and critical conditions. Tidal waterbodies are

difficult to assess given the dynamic flow regime, flushing characteristics, spatial and temporal variability in pathogen sources and contributions, watershed characteristics, and other factors. Seasonal trends were evaluated to determine the critical condition period for TMDL development. The results of this analysis indicated that bacteria concentrations were typically higher during summer months. The influx of summer vacationers and the resulting increase in septic and potential leaking sewer volumes, increased marina and boat use, and other factors contribute to this seasonal trend. Rainfall and flow impacts were also evaluated, but correlation results did not show a clear relationship between bacteria concentrations and these factors. As a result, TMDLs were developed based on summer data collected at the "worst case" station identified for each waterbody (or sub-group). Figure 4 shows the seasonal trend in shellfish monitoring data for "worst case" stations located in WMA 17. This conservative approach takes into account seasonal variation and critical conditions because only the data collected during summer months were used to identify "worst case" stations and for determining the TMDL percent reduction required and load allocations. These assumptions are consistent with previous freshwater TMDLs developed in New Jersey and recent shellfish TMDLs developed in New York.

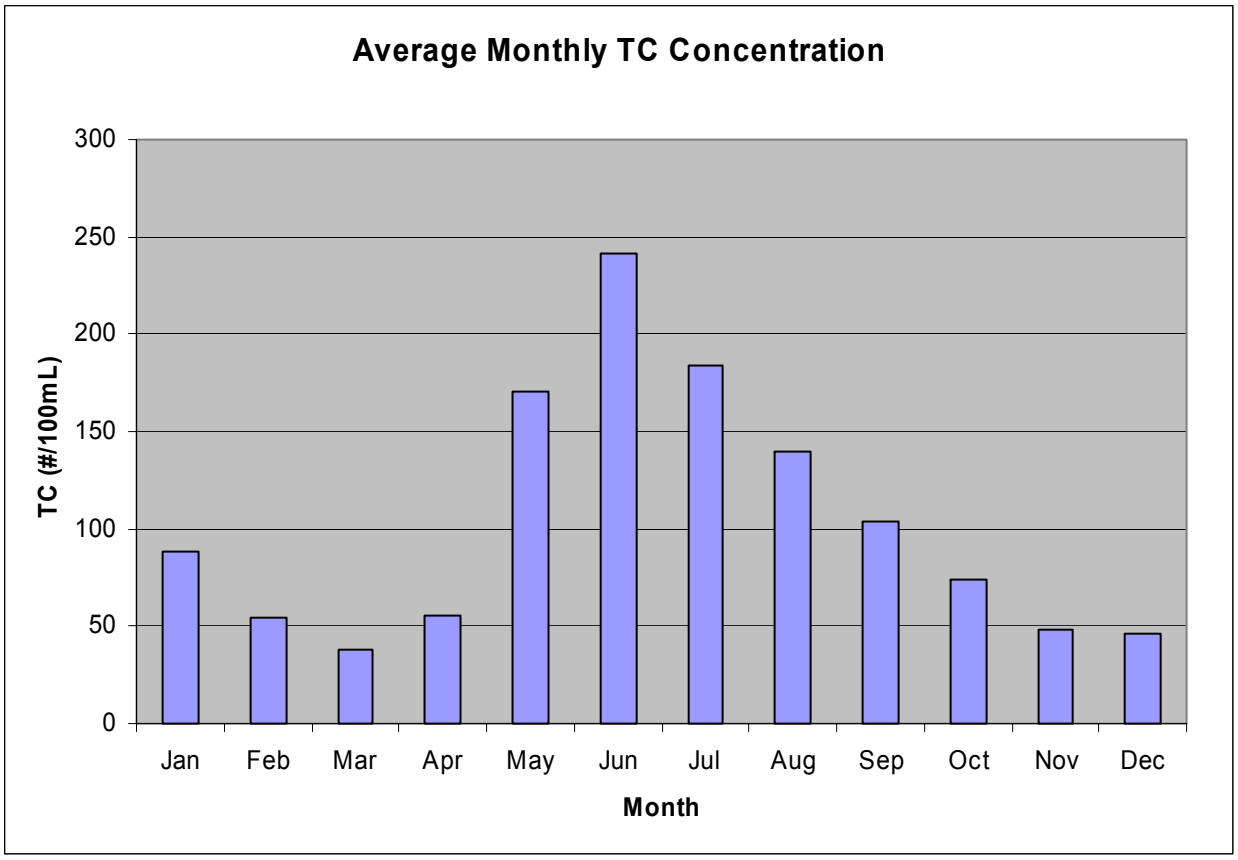

Figure 4. Seasonal trend in TC data for all worst case stations in WMA 17

4.2 Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). For these TMDLs, both an implicit and explicit Margin of Safety (MOS) were incorporated. An implicit MOS was incorporated by using conservative assumptions, including the use of "worst case" stations to determine the percent reduction required, using data collected during the summer critical condition period to develop TMDLs, treating total coliform as a conservative substance (source loads were estimated without including die-off rates, soil incorporation, etc.), using conservative methods to estimate land-based loads, and other factors. In addition, a 5% explicit MOS was calculated for each TMDL eligible waterbody.

5.0 TMDL CALCULATIONS

TMDLs were developed based on the percent reduction calculated by comparing the data collected at each "worst case" station to the NSSP criteria for total coliform. The overall percent reduction (including a minimum explicit 5% MOS) was calculated and load reductions for point and nonpoint sources were estimated. The percent reduction specified for each waterbody (or sub-group) was applied equally to pathogen sources in each watershed for which source reductions measures can reasonably be applied. The loads contributed by forest lands and barren lands were not reduced in the TMDL allocation because these loads represent natural background levels (e.g. wildlife contributions) and/or sources that cannot be reasonably reduced. As a result, existing loads from these sources are equal to the future loads. Therefore, the load reduction from land uses and marinas for which reduction measures can reasonably be applied must be increased proportionally, as presented in Table 9.

The TMDL was allocated among point and nonpoint sources. Wastewater treatment plants typically have a negligible discharge due to required disinfection practices designed to reduce and/or eliminate the bacteria concentration in wastewater. These point source loads were, therefore, considered de minimus discharges and were assigned a WLA of zero. Stormwater from Tier A municipalities was assigned a WLA, while Tier B municipalities, non-urban land uses and marinas were assigned LAs.

5.1 Wasteload Allocations and Load Allocations

WLAs were established for point source discharges within each watershed and for municipal stormwater discharges subject to regulation under the CWA. LAs were established for all stormwater sources that are not subject to regulation under the CWA and for all other nonpoint sources. Stormwater point sources that received a WLA were distinguished from stormwater sources receiving a LA on the basis of land use type and municipal tier designation (Tier A/Tier B).

This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously.

Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore, allocations are established according to source categories as shown in Table 7. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the residential, commercial, industrial and mixed urban runoff source categories that are not NJPDES-regulated. Nothing in these TMDLs shall be construed to require the Department to regulate a stormwater source under NJPDES that would not already be regulated as such, nor shall anything in these TMDLs be construed to prevent the Department from regulating a stormwater source under NJPDES.

Table 7. Assignment of WLAs and LAs for stormwater point sources and nonpoint sources

Land Use Source Category	Municipal Tier	TMDL Allocation Type
High density residential	A	WLA
Medium density residential (incl. mixed residential, mixed urban, other urban, military reservations, and no longer military)	A	WLA
Low density residential (incl. rural residential, recreational land, and athletic fields)	A	WLA
Commercial	A	WLA
Industrial	A	WLA
Roadways	A	WLA
High density residential	B	LA
Medium density residential (incl. mixed residential, mixed urban, other urban, military reservations, and no longer military)	B	LA
Low density residential (incl. rural residential, recreational land, and athletic fields)	B	LA
Commercial	B	LA
Industrial	B	LA
Roadways	B	LA
Agricultural	N/A	LA
Forest	N/A	LA
Barren land	N/A	LA

Note: Wetland areas were not included in load estimates based on model assumptions.

A summary of the WLAs, LAs and MOS is provided for each subject waterbody (or sub-group) in Table 8 and source loads and allocations are presented in Table 9. The loads contributed by forest lands and barren lands were not reduced in the TMDL allocation table, as described above. The load reduction for controllable sources (i.e. urban lands, agricultural lands, and marinas) was increased proportionally to meet the overall percent reduction required for each waterbody (or subgroup).

Table 8. TMDL calculations for shellfishing impaired waters in WMA 17

Waterbody	Subgroup	WLA		LA		MOS		TMDL	Overall Percent Reduction
		Load (cfu/yr)	Percent of TMDL	Load (cfu/yr)	Percent of TMDL	Load (cfu/yr)	Percent of TMDL		
Cedar Creek Estuary-17	B	0.00E+00	0%	4.25E+14	95%	2.24E+13	5%	4.47E+14	22%
Cohansey River Estuary	-	4.05E+05	0%	6.10E+13	95%	3.21E+12	5%	6.42E+13	72%
Delaware Bay	B	1.27E+15	16%	6.36E+15	79%	4.01E+14	5%	8.03E+15	13%
Delaware Bay	F	3.31E+15	42%	4.25E+15	53%	3.98E+14	5%	7.95E+15	77%
Maurice River Estuary and Cove	-	2.97E+15	40%	4.02E+15	55%	3.68E+14	5%	7.36E+15	78%
Middle Marsh Creek Estuary	-	0.00E+00	0%	3.08E+13	95%	1.62E+12	5%	3.25E+13	22%
Nantuxent Creek Estuary	-	0.00E+00	0%	2.31E+14	95%	1.22E+13	5%	2.43E+14	46%
Oranoaken Creek Estuary	-	0.00E+00	0%	7.49E+11	95%	3.94E+10	5%	7.89E+11	47%

Table 9. WMA 17 land-based load allocations

Waterbody	Subgroup	Overall % Reduction	Agriculture (LA)			Barren Land (LA)			Forest (LA)			Urban Total (WLA)			Urban Total (LA)			Marinas (LA)			MOS	TMDL
			Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)	Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)	Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)	Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)	Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)	Existing Load (cfu/yr)	Percent Reduction	Allocated Load (cfu/yr)		
Cedar Creek Estuary-17	B	22%	1.51E+14	25%	1.14E+14	4.77E+11	0%	4.77E+11	6.74E+13	0%	6.74E+13	0.00E+00	N/A	0.00E+00	3.23E+14	25%	2.43E+14	0.00E+00	N/A	0.00E+00	2.24E+13	4.47E+14
Cohansey River Estuary	-	72%	2.78E+06	72%	7.69E+05	1.14E+04	0%	1.14E+04	4.28E+05	0%	4.28E+05	1.46E+06	72%	4.05E+05	3.78E+06	72%	1.05E+06	2.20E+14	72%	6.10E+13	3.21E+12	6.42E+13
Delaware Bay	B	13%	2.81E+15	13%	2.44E+15	1.19E+13	0%	1.19E+13	4.33E+14	0%	4.33E+14	1.46E+15	13%	1.27E+15	3.79E+15	13%	3.28E+15	2.20E+14	13%	1.91E+14	4.01E+14	8.03E+15
Delaware Bay	F	77%	4.65E+15	84%	7.57E+14	7.73E+13	0%	7.73E+13	2.56E+15	0%	2.56E+15	2.03E+16	84%	3.31E+15	4.65E+15	84%	7.58E+14	5.93E+14	84%	9.66E+13	3.98E+14	7.95E+15
Maurice River Estuary and Cove	-	78%	4.60E+15	85%	6.74E+14	7.46E+13	0%	7.46E+13	2.54E+15	0%	2.54E+15	2.03E+16	85%	2.97E+15	4.39E+15	85%	6.44E+14	5.93E+14	85%	8.68E+13	3.68E+14	7.36E+15
Middle Marsh Creek Estuary	-	22%	2.54E+13	25%	1.90E+13	4.40E+11	0%	4.40E+11	5.02E+12	0%	5.02E+12	0.00E+00	N/A	0.00E+00	8.49E+12	25%	6.36E+12	0.00E+00	N/A	0.00E+00	1.62E+12	3.25E+13
Nantuxent Creek Estuary	-	46%	8.82E+13	56%	3.88E+13	8.54E+11	0%	8.54E+11	7.68E+13	0%	7.68E+13	0.00E+00	N/A	0.00E+00	1.34E+14	56%	5.90E+13	1.26E+14	56%	5.55E+13	1.22E+13	2.43E+14
Oranoaken Creek Estuary	-	47%	0.00E+00	N/A	0.00E+00	1.84E+11	0%	1.84E+11	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	0.00E+00	1.23E+12	54%	5.65E+11	0.00E+00	N/A	0.00E+00	3.94E+10	7.89E+11

5.2 Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included for the subject waters. Wastewater treatment facilities will continue to be required to achieve disinfection. Nonpoint source reduction strategies applied to land uses will be equally effective with respect to existing and future use of the land.

6.0 FOLLOW - UP MONITORING

The Department maintains a large network of monitoring stations throughout the State's coastal region. The Department's Bureau of Marine Water Monitoring collects water quality data to determine compliance with the National Shellfish Sanitation Program, for the evaluation of the ecological health of coastal waters, and to monitor, identify and track pollution sources impacting the State's coastal waters. Shellfish monitoring data collected the Bureau and information on pollution sources within each watershed and waterbody were used to identify the shellfish-impaired waters that are the subject of these TMDLs. Pathogen indicator data will continue to be collected by the Bureau on a routine basis to assess changes in water quality over time and to determine compliance with the NSSP criteria for shellfish growing areas.

7.0 IMPLEMENTATION

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, citing criteria, operating methods, or other alternatives" (USEPA, 1993).

Development of effective management measures depends on accurate source assessment. Coliform bacteria is contributed to the environment from a number of categories of sources including human, domestic or captive animals, agricultural practices, and wildlife. Coliform bacteria from these sources can reach waterbodies directly, through overland runoff, or through sewage or stormwater conveyance facilities. Each potential source will respond to one or more management strategies designed to eliminate or reduce that source of coliform bacteria. Each management strategy has one or more entities that can take lead responsibility to effect the strategy. Various funding sources are available to assist in accomplishing the management strategies. The Department will address the sources of impairment through systematic source trackdown, matching strategies with sources, selecting responsible entities and aligning available resources to effect implementation.

For example, the stormwater discharged to the impaired waterbodies through "municipal separate storm sewer systems" (MS4s) are regulated under the Department's Municipal Stormwater Regulation Program. Under these rules and associated general permits, many municipalities (and various county, State, and other agencies) will be required to implement

various control measures that should substantially reduce bacteria loadings, including measures to eliminate "illicit connections" of domestic sewage and other waste to the MS4s, adopt and enforce a pet waste ordinance, prohibit feeding of unconfined wildlife on public property, clean catch basins, perform good housekeeping at maintenance yards, and provide related public education and employee training. These measures are to be phased in over a timeframe specified in the Department's Municipal Stormwater permitting program. The Department will use its Water Quality Management Planning program to expedite implementation of these measures where amendments to areawide Water Quality Management Plans are proposed. The Department has provided State funds as well as a portion of its Clean Water Act 319(h) pass through grant funds to assist municipalities in meeting these requirements.

Sewage conveyance facilities are potential sources of fecal coliform in that equipment failure or operational problems may result in the release of untreated sewage. These sources, once identified, can be eliminated through appropriate corrective measures that can be effected through the Department's enforcement authority. Inadequate on-site sewage disposal can also be a source of fecal coliform. Systems that were improperly designed, located or maintained may result in surfacing of effluent; illicit remedies such as connections to storm sewers or streams add human waste directly to waterbodies. Once these problems have been identified through local health departments, sanitary surveys or other means, alternatives to address the problems can be evaluated and the best solution implemented. The New Jersey Environmental Infrastructure Financing Program, which includes New Jersey's State Revolving Fund, provides low interest loans to assist in correction of water quality problems related to stormwater and wastewater management.

Geese are migratory birds that are protected by the Migratory Bird Treaty Act of 1918 and other Federal and State Laws. Resident Canada geese do not migrate, but are nevertheless protected by this and other legislation. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS)-Wildlife Services program reports that the 1999 estimated population of non-migratory geese in New Jersey was 83,000. Geese may produce up to 1½ pounds of fecal matter a day and when the congregate in large numbers they can represent a locally significant source of coliform bacteria. This may warrant taking steps to reduce populations in these areas.

Because geese are free to move about and commonly graze and rest on large grassy areas associated with schools, parks, golf courses, corporate lawns and cemeteries, measures to reduce populations, where necessary, are best developed and conducted at the community level through a community-based goose damage management program. USDA's Wildlife Services program recommends that a community prepare a written Canada Goose Damage Management Plan that may include the following actions:

- Initiate a fact-finding and communication plan
- Enact and enforce a "no feeding" ordinance
- Conduct goose damage control activities such as habitat modification
- Review and update land use policies

- Reduce or eliminate goose reproduction (permit required)
- Hunt geese to reinforce nonlethal actions (permit required)

Procedures such as handling nests and eggs, capturing and relocating birds, and the hunting of birds require a depredation permit from either the USDA APHIS Wildlife Services or U.S. Fish and Wildlife Services. Procedures requiring permits should be a last resort after a community has exhausted the other listed measures. The Department's draft guide *Management of Canada Geese in Suburban Areas, March 2001,* which may be found at www.state.nj.us/dep/watershedmgt under publications, provides extensive guidance on how to modify habitat to serve as a deterrent to geese as well as other prevention techniques such as education through signage and ordinances.

In coastal areas, other waterfowl are naturally present in significant numbers and vary seasonally with migratory patterns. Other wildlife contributions may include deer populations, which have been identified as a potential fecal coliform source in the impaired watersheds. The forested and low-density residential areas that provide deer habitat can be found in close proximity to the impaired stream segments. Deer have been evaluated in fecal coliform TMDLs by other States (e.g. Alabama and South Carolina) and could be a fecal coliform source in New Jersey. Management measures to reduce coliform bacteria contributed by wildlife are not generally practicable.

Agricultural activities are another example of potential sources of coliform bacteria. Possible contributors are direct contributions from livestock permitted to traverse streams and stream corridors, manure management from feeding operations, or use of manure as a soil fertilizer/amendment. Implementation of conservation management plans and best management practices are the best means of controlling agricultural sources of coliform bacteria. Several programs are available to assist farmers in the development and implementation of conservation management plans and best management practices. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

- **The Environmental Quality Incentive Program (EQIP)** is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

- **The Conservation Reserve Program (CRP)** is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the

establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

- **The Conservation Reserve Enhancement Program** The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, have established a $100 million dollar CREP agreement. The program matches $23 million of State money with $77 million from the Comodity Credit Corporation within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP will be part of the USDA's Conservation Reserve Program (CRP). There will be a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program thereby making these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

Uses of the marine environment as a recreational area and receiving water have the potential to contribute pathogen loads. As part of the Governor's Coast 2005 initiative, the Department has taken many steps toward stronger protection for water quality and habitat, including:

- The Department has worked to strengthen standards for ocean dischargers to avoid impacts to water quality. The Department requires implementation of measures that will prevent catastrophic sewage spills though the maintenance and upgrading of aging infrastructure.
- The Department targets $30 million in grants to accelerate projects that improve coastal water quality.
- The Department partners with other state agencies, non-profit groups, trade organizations, and marina owners to activate the "New Jersey Clean Marina" program.
- New Jersey will work with anglers, environmentalists, and the New Jersey congressional delegation to establish a "Clean Ocean Zone" to protect water quality in the NY/NJ Bight by eliminating and preventing pollution.

In March 2005, the New Jersey Clean Marina Program was established. It is a voluntary education program that provides information, guidance, and technical assistance to marina operators, local government, and recreational boaters regarding the most effective practices to protect water quality and coastal resources. Marina and boat operational and maintenance activities can contribute to nonpoint source pollution by discharging substances such as oil, grease, paint and cleaning chemicals, and fish waste. This Program gives marina managers the information they need to reduce these incidental effects of their activities. Facilities that meet the requirements of the Program are recognized as "Clean Marinas." By adopting pollution prevention measures, marina owners and managers can engage in environmentally responsible operations and management of their facility. The New Jersey Clean Marina Program is a partnership among state and federal government agencies, trade associations,

marine businesses and other interested parties. The Department website (www.njcleanmarina.org) contains more information and a complete list of participating agencies and organizations.

Another program designed for coastal water quality improvement is New Jersey's Clean Vessel Act (CVA) Committee. Passed by the Congress in 1992, the CVA helps reduce pollution from vessel sewage discharges. Federal grants are available to states on a competitive basis for the construction and/or renovation, operation and maintenance of pumpout and portable toilet dump stations. Currently, states submit grant proposals, by May 1st of each year, to one of seven Fish and Wildlife Service regional offices for review. The service's Division of Federal Aid then convenes a panel including representatives from the Service's Washington Office of the Division of Federal Aid, the National Oceanic and Atmospheric Administration (NOAA), the USEPA, and the U.S. Coast Guard. The panel reviews, ranks and makes funding recommendations to the Director of the Fish and Wildlife Service. The Director gives priority consideration to grant proposals which provide installation and/or operation of pumpout and dump stations under federally approved state plans.

All recreational vessels must have access to pumpouts funded under the Clean Vessel Act. NOAA will mark pumpout and dump station locations on its nautical charts. Halfway through the program, grants have been awarded to install 1,200 pumpout stations and 630 dump stations. A maximum fee of $5.00 may be charged for the use of pumpout facilities constructed or maintained with grant funds.

As part of this program, four CVA funded pumpout boats are in service in New Jersey. They are operated by the Borough of Seaside Park, by Monmouth County, and by Ocean County. Pumpout boats can pull up along side a recreational boat and pump out its sewage holding device with a suction hose. Once a pumpout boat is full of waste, it discharges the waste into a sewage treatment facility for proper disposal.

Management strategies are summarized below in Table 10.

Table 10. Implementation management strategies

Source Category	Responses	Potential Responsible Entity	Funding options
Human Sources			
Inadequate (per design, operation, maintenance, location, density) on-site disposal systems	Sanitary surveys, septic management programs/ordinances	Municipality	CWA 604(b) for confirmation of inadequate condition; Environmental Infrastructure Financing Program for construction of selected option

Source Category	Responses	Potential Responsible Entity	Funding options
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Municipal Stormwater permitting program including any additional measures determined in the future to be needed through TMDL process	Municipality, State and County regulated entities, stormwater utilities	CWA 319(h); Environmental Infrastructure Financing Program for construction of selected option
Malfunctioning sewage conveyance facilities	Identify through source trackdown and repair	Owner of malfunctioning facility--compliance issue	User fees
Marinas	Clean Marina Program; No Discharge Zones; Marina BMPs including: Marine pump-out facilities; Marina flushing design; Fish waste management including fish-cleaning restrictions, public education, and fish waste disposal; Proper sewage handling including: installing a sanitary pump-out system, providing on-shore restrooms, provide accommodations for emptying potable Marine Sanitation Devices (MSDs), safeguarding and maintaining septic systems, providing live aboard facilities, offering MSD inspections, encouraging compliance, and educating boaters.	Marina property owner; Municipalities for ordinance adoption and compliance	State sources and CWA319(h) assistance for BMPs
Domestic/captive animal sources			
Pets	Pet waste ordinances	Municipalities for ordinance adoption and compliance	State source and CWA 319(h) assistance to municipalities to implement municipal stormwater regulations
Horses, livestock, zoos	Confirm through source trackdown: SCD/NRCS develop conservation management plans	Property owner	EQIP, CRP, CREP

Source Category	Responses	Potential Responsible Entity	Funding options
Agricultural practices	Confirm through source trackdown; SCD/NRCS develop conservation management plans, exercise CAFO/AFO authority if applicable	Property owner	EQIP, CRP, CREP
Wildlife			
Locally excessive populations of resident Canada geese or other waterfowl	Feeding ordinances; Goose Management BMPs	Municipality for ordinance; local community groups for BMPs	State source; CWA 319(h)
Indigenous wildlife	Confirm through trackdown; riparian buffer restoration; consider revising designated uses	State	State source

7.1 Source Trackdown

Sewage Infrastructure Improvement Act (SIIA)

N.J.A.C. 7:22A was originally adopted by the Department on December 29, 1989 (see 22 N.J.R. 368(a)) to implement the Sewage Infrastructure Improvement Act (SIIA), N.J.S.A. 58:25-23 et seq. The SIIA has two main components: (1) to address discharges from combined sanitary and stormwater sewer systems (CSO) throughout the State (planning and design grants for CSOs) and (2) to map and investigate stormwater sewer systems in Atlantic, Cape May, Monmouth and Ocean counties (stormwater mapping grants). The SIIA, which became effective on August 3, 1988, was designed to address nonpoint and point sources of pollution from stormwater sewer systems and combined sewer overflow points. The New Jersey Legislature has declared that these sources of pollution contribute greatly to the biological and chemical degradation of coastal and surface waters of the state. The SIIA recognized that nonpoint sources of pollution create public health dangers and mandate beach and shellfish bed closings by contributing high levels of bacteria to surface waters through stormwater sewer systems. The SIIA also recognized that overflows of raw sewage from combined sewer systems are another major source of water pollution and established various requirements for municipalities and public entities to address these pollution problems.

The SIIA required all municipalities with stormwater sewer systems discharging into the salt waters of Monmouth, Ocean, Atlantic or Cape May counties to prepare and submit a map of their sanitary and stormwater sewer systems and to conduct periodic stormwater monitoring of outfalls discharging to saltwater. Grant funding was provided for mapping, sampling and identification of cross connections and interconnections between the stormwater and sanitary sewers. This work is essentially complete and will inform implementation efforts.

While there are no CSOs in the waterbodies addressed in this TMDL report, it should be noted that significant source reduction strategies have been and continue to be put in place to address this source of pathogens in other waterbodies, such as the New York/New Jersey Harbor, which will be addressed in future TMDL efforts.

Pathogen Indicators and Microbial Source Tracking:

Advances in microbiology and molecular biology have produced several methodologies that discriminate among sources of fecal coliform and thus more accurately identify pathogen sources. The numbers of pathogenic microbes present in polluted waters are few and not readily isolated nor enumerated. Therefore, analyses related to the control of these pathogens must rely upon indicator microorganisms. The commonly used pathogen indicator organisms are the coliform groups of bacteria, which are characterized as gram-negative, rod-shaped bacteria. Coliform bacteria are suitable indicator organism because they are generally not found in unpolluted water, are easily identified and quantified, and are generally more numerous and more resistant than pathogenic bacteria (Thomann and Mueller, 1987).

Tests for fecal organisms are conducted at an elevated temperature (44.5°C), where the growth of bacteria of non-fecal origin is suppressed. While correlation between indicator organisms and diseases can vary greatly, as seen in several studies performed by the EPA and others, two indicator organisms *Esherichia coli* (*E. coli*) and enterococci species showed stronger correlation with incidence of disease in bathers than fecal coliform (USEPA, 2001). Similar epidemiological studies for shellfish consumption have not been performed for *E. coli* or enterococci. Recent advances have allowed for more accurate identification of pathogen sources. A few of these methods, including, molecular, biochemical, and chemical are briefly described in the following paragraph.

Molecular (genotype) methods are based on the unique genetic makeup of different strains, or subspecies, of fecal bacteria (Bowman et al, 2000). An example of this method includes "DNA fingerprinting" (i.e., a ribotype analysis which involves analyzing genomic DNA from fecal *E. coli* to distinguish human and non-human specific strains of *E. coli*.). Biochemical (phenotype) methods include those based on the effect of an organism's genes actively producing a biochemical substance (Graves et al., 2002; Goya et al 1987). An example of this method is multiple antibiotic resistance (MAR) testing of fecal *E. coli*. In MAR testing, *E. coli* are isolated from fecal samples and exposed to 10-23 different antibiotics. In theory, *E. coli* originating from wild animals should show resistance to a smaller number of antibiotics than *E. coli* originating from humans or pets. Given this general trend, MAR patterns or '"signatures" can be defined for each class of *E. coli* species. Chemical methods are based on finding chemical compounds associated with human wastewater, and useful in determining if the sources are human or non-human. Such methods measure the presence of optical brighteners, which are contained in all laundry detergents, and soap surfactants in the water column. Unlike the optical brightener method, the measurement of surfactants may allow for some quantification of the source.

MST methods have already been successfully employed at the Department in the past decade. Since 1988, the Department has worked cooperatively with the University of North Carolina in developing and determining the application of RNA coliphage as a pathogen indicator. This research was funded through USEPA and Hudson River Foundation grants. These studies showed that the RNA coliphages are useful as an indicator of fecal contamination; particularly in chlorinated effluents and that they can be serotyped to distinguish human and animal fecal contamination. Through these studies, the Department has developed an extensive database of the presence of coliphages in defined contaminated areas (point human, non-point human, point animal, and non-point animal).

More recently, the Department has established a MST methodology that utilizes both genotype (genotyping of F+RNA coliphages) and phenotype (MAR testing) tests. The results of these tests are collectively evaluated to best determine sources of fecal contamination. The methodology includes evaluation of long-term microbial results as well as data (GIS Land use coverage, aerial photographs, and visual assessments) of actual and potential sources, stormwater monitoring to delineate the location of major sources and the use of MAR and F+ coliphage in conjunction with conventional microbial indicators. This methodology has been successfully applied in several areas including Seaside Park, Long Swamp, Atlantic City, and Parvin State Park. This methodology may be utilized for select TMDL waterbodies.

7.2 Specific Projects

In addition to generic strategies described previously, a number of projects have been undertaken which are expected to aid in achieving the load reductions assigned to the impaired waterbodies. Ongoing activities to develop and implement watershed restoration plans are expected to result in additional specific projects to reduce pollutant loads.

Table 11. WMA 17 Outreach and Restoration Projects

WMA	FY	Funding Source	Recipient	Project Title	Grant Amount
17	2000	319	Salem County Dept of Planning	Salem County GreenKeepers Plan	$101,000.00
17	2002	319	Citizens United to Protect the Maurice River and its Tributaries	Parvin Branch and Tarklin Brook Assessment and Monitoring	$56,450.00
17	2003	319	Daretown Lake Association, Inc.	A Non-Point Source Pollution Analysis of the Upper Salem River and Daretown Lake Watersheds	$63,220.00
State	1998	319	Rutgers Department of Environmental Services	BMPs for the use of Non-traditional Organic Wastes in Agriculture	$79,000.00
17	2005	319	Rutgers	Watershed Restoration Plan for the Upper Cumberland Cohansey River Watershed	$20,000.00

8.0 REASONABLE ASSURANCE

With the implementation of follow-up monitoring, source identification and source reduction as described in general and for WMA 17, the Department has reasonable assurance that a significant increase in the shellfish designated use will be attained. The results of trackdown and follow up ambient monitoring will be evaluated to determine effectiveness of the identified measures and if additional measures are needed.

9.0 PUBLIC PARTICIPATION

The Water Quality Management Planning rules at N.J.A.C. 7:15-7.2 requires the Department to initiate a public process prior to the development of each TMDL to provide an opportunity for public input to the Department on policy issues affecting the development of the TMDL. Further, the Department shall propose each TMDL as an amendment to the appropriate areawide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g).

For the set of TMDLs developed to address shellfish impairment in coastal waters, the Department conducted three outreach sessions: November 17, 2005 for WMAs 12 and 13 with the Barnegat Bay Advisory Committee at Ocean County College; December 15, 2005 for WMAs 14, 15, and 16 at the Galloway Township Library in Galloway, New Jersey; and January 3, 2006 for WMAs 16 and 17 at the Commercial Township Municipal Building in Port Norris. During the sessions, the Department presented the TMDL process, the locations of impaired shellfish waterbodies, and potential methods to achieve bacteria source reductions. GIS maps aided in soliciting information regarding potential sources within each watershed.

10.0 AMENDMENT PROCESS

Notice proposing these TMDLs was published February 21, 2006 in the New Jersey Register and in newspapers of general circulation in order to provide the public an opportunity to review the TMDL document and submit formal comments. In addition, a public hearing will be held on March 23, 2006 at the Ocean County Community College – Toms River Campus in the Technology Building Lecture Hall. There will be an informal presentation from 7:00 p.m. to 7:30 p.m., which will be followed by the public hearing from 7:30 p.m. to 9:00 p.m., or until the end of testimony, whichever is earlier. The public comment period will remain open for 15 days following the public hearing. Notice of the proposal and hearing was provided to affected municipalities in the watershed.

All comments received during the public notice period and at the public hearing will become part of the record for this TMDL and will be considered in the Department's decision to establish this TMDL through submittal to EPA Region 2. Once approved by EPA, this TMDL will be adopted as an amendment to the Atlantic County, Cape May County, Tri-County, and Lower Delaware Water Quality Management Plans in accordance with New Jersey's Water Quality Management Planning Rules at N.J.A.C. 7:15-3.4 (g).

APPENDIX A: REFERENCES

Bacteria Load Estimation methods used to estimate land-based bacteria load contributions: (1) Toms River studies – USGS (May 2005); (2) Loading Coefficient Analysis and Selection Tool (LCAST). Developed by NJDEP and Tetra Tech, December 2001.; (3) Watershed Treatment Model (WTM). Developed by the Center for Watershed Protection in July 2001; (4) Simple Method for calculating bacteria loads (Schueler, T. 1987).

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APPENDIX B: NJPDES WASTEWATER TREATMENT FACILITIES

WMA 17 Wastewater Treatment Facilities

Waterbody	Subgroup	NJPDES ID	Facility Name	Pipe	Design Flow** (MGD)	FC Limit	Permit Category*	Receiving Waters
Cohansey River Estuary	-	NJ0024651	Cumberland County UA	001A	7	200 MoGeoAvg	A	Cohansey River
Delaware Bay Tribs-Tidal	A	NJ0004405	Unimin Corp - Dividing Crk	002A	1.822	200 MoGeoAvg	A	Cub Swamp
Delaware Bay	A	NJ0025411	PSE&G - Hope Creek NGS	461C	48	200 MoGeoAvg	B	Delaware River Zone 5)(saline)
		NJ0025411	PSE&G - Hope Creek NGS	462B	48	200 MoGeoAvg	A	Delaware River Zone 5 (saline)
		NJ0062201	Lower Alloways Ck - Canton Village	001A	0.05	200 MoGeoAvg	A	Stow Creek via storm sewer
	B	NJ0024651	Cumberland County UA	001A	7	200 MoGeoAvg	A	Cohansey River
	F	NJ0029467	Millville City	001A	5	200 MoGeoAvg	A	Maurice River
		NJ0029581	John T Handy Co Inc	001A	2.9	Report Only	B	Maurice River
		NJ0029581	John T Handy Co Inc	002A	2.9	Report Only	B	Maurice River
		NJ0029696	Bivalve Packing Co Inc	001A	0.0094	Report Only	B	Maurice River
		NJ0102849	Bayside State Prison WTP	001A	0.55	200 MoGeoAvg	A	Riggins Ditch
	G	NJ0004405	Unimin Corp - Dividing Crk	002A	1.822	200 MoGeoAvg	A	Cub Swamp
Maurice River Estuary and Cove	-	NJ0029467	Millville City	001A	5	200 MoGeoAvg	A	Maurice River
		NJ0029581	John T Handy Co Inc	001A	2.9	Report Only	B	Maurice River
		NJ0029581	John T Handy Co Inc	002A	2.9	Report Only	B	Maurice River
		NJ0029696	Bivalve Packing Co Inc	001A	0.0094	Report Only	B	Maurice River

*Permit Categories: A = Sanitary Surface Water Discharge; A8 = Discharge to Reg. Outfall Auth.; B = Industrial/Commercial Surface Water; RF = Stormwater; 05 = Stormwater Runoff

** Design Flow reflects the design capacity of the entire treatment facility, and does not indicate individual pipe/outfall capacity.

APPENDIX C: MUNICIPALITIES

WMA 17 Tier A and Tier B Municipalities

Tier	Waterbody	Subgroup	Municipality	NJPDES Number
A	Cohansey River Estuary	-	BRIDGETON CITY	NJG0147826
	Delaware Bay	B	BRIDGETON CITY	NJG0147826
		F	BUENA BORO	NJG0149214
			BUENA VISTA TWP	NJG0154989
			CLAYTON BORO	NJG0150754
			FRANKLIN TWP	NJG0151025
			GLASSBORO BORO	NJG0148270
			MILLVILLE CITY	NJG0149063
			MONROE TWP	NJG0148946
			NEWFIELD BORO	NJG0149187
			PITTSGROVE TWP	NJG0154512
			VINELAND CITY	NJG0152765
			WASHINGTON TWP	NJG0153664
		H	DENNIS TWP	NJG0150291
			MIDDLE TWP	NJG0149250
	Maurice River Estuary and Cove	-	BUENA BORO	NJG0149314
			BUENA VISTA TWP	NJG0154989
			CLAYTON BORO	NJG0150754
			FRANKLIN TWP	NJG0151025
			GLASSBORO BORO	NJG0148270
			MILLVILLE CITY	NJG0149063
			MONROE TWP	NJG0148946
			NEWFIELD BORO	NJG0149187
			PITTSGROVE TWP	NJG0154512
			VINELAND CITY	NJG0152765
			WASHINGTON TWP	NJG0153664
B	Beck Creek Estuary	-	FAIRFIELD TWP	NJG0152684
			LAWRENCE TWP	NJG0151696
	Cedar Creek Estuary-17	-	LAWRENCE TWP	NJG0151696
	Cohansey River Estuary	-	ALLOWAY TWP	NJG0152731
			DEERFIELD TWP	NJG0154750
			FAIRFIELD TWP	NJG0152684
			GREENWICH TWP	NJG0154083
			HOPEWELL TWP	NJG0154903
			LAWRENCE TWP	NJG0151696
			SHILOH BORO	NJG0154857
			STOW CREEK TWP	NJG0154962
			UPPER DEERFIELD TWP	NJG0149624
			UPPER PITTSGROVE TWP	NJG0155110
	Delaware Bay Tribs-Tidal	A	COMMERCIAL TWP	NJG0149608
			DOWNE TWP	NJG0151297
		B	DOWNE TWP	NJG0151297
	Delaware Bay	A	ALLOWAY TWP	NJG0152731
			GREENWICH TWP	NJG0154083
			HOPEWELL TWP	NJG0154903
			LOWER ALLOWAYS CREEK TWP	NJG0148369
			QUINTON TWP	NJG0150207

Tier	Waterbody	Subgroup	Municipality	NJPDES Number
			SHILOH BORO	NJG0154857
			STOW CREEK TWP	NJG0154962
		B	ALLOWAY TWP	NJG0152731
			DEERFIELD TWP	NJG0154750
			FAIRFIELD TWP	NJG0152684
			GREENWICH TWP	NJG0154083
			HOPEWELL TWP	NJG0154903
			LAWRENCE TWP	NJG0151696
			SHILOH BORO	NJG0154857
			STOW CREEK TWP	NJG0154962
			UPPER DEERFIELD TWP	NJG0149624
			UPPER PITTSGROVE TWP	NJG0155110
		C	DOWNE TWP	NJG0151297
			FAIRFIELD TWP	NJG0152684
			LAWRENCE TWP	NJG0151696
		D	DOWNE TWP	NJG0151297
		E	DOWNE TWP	NJG0151297
		F	COMMERCIAL TWP	NJG0149608
			DEERFIELD TWP	NJG0154750
			DOWNE TWP	NJG0151297
			ELK TWP	NJG0148997
			ELMER BORO	NJG0148377
			FAIRFIELD TWP	NJG0152684
			LAWRENCE TWP	NJG0151696
			MAURICE RIVER TWP	NJG0151181
			UPPER DEERFIELD TWP	NJG0149624
			UPPER PITTSGROVE TWP	NJG0155110
		G	COMMERCIAL TWP	NJG0149608
			DOWNE TWP	NJG0151297
		H	MAURICE RIVER TWP	NJG0151181
			WOODBINE BORO	NJG0149721
	Maurice River Estuary and Cove	-	COMMERCIAL TWP	NJG0149608
			DEERFIELD TWP	NJG0154750
			DOWNE TWP	NJG0151297
			ELK TWP	NJG0148997
			ELMER BORO	NJG0148377
			FAIRFIELD TWP	NJG0152684
			LAWRENCE TWP	NJG0151696
			MAURICE RIVER TWP	NJG0151181
			UPPER DEERFIELD TWP	NJG0149624
			UPPER PITTSGROVE TWP	NJG0155110
	Middle Marsh Creek Estuary	-	FAIRFIELD TWP	NJG0152684
	Nantuxent Creek Estuary	-	DOWNE TWP	NJG0151297
			LAWRENCE TWP	NJG0151696
	Oranoaken Creek Estuary	-	DOWNE TWP	NJG0151297
	Straight Creek Estuary	-	DOWNE TWP	NJG0151297

APPENDIX D: MARINA LOADING ESTIMATES

WMA 17 Marina Loading Estimates

Waterbody	Subgroup	Marina Name	Load (cfu)
Beck Creek Estuary	-	HUSTEDS LANDING MARI	3.77928E+13
Cedar Creek Estuary-17	B	CEDARVILLE MARINA	0
Cohansey River Estuary	-	FAIRTON MARINA	0
		GREENWICH BOAT WORKS	1.4661E+14
		HANCOCKS HARBOR MARI	7.36493E+13
Delaware Bay	A	PRIVATELY OWNED MARI	1.39628E+13
	B	FAIRTON MARINA	0
		GREENWICH BOAT WORKS	1.4661E+14
		HANCOCKS HARBOR MARI	7.36493E+13
	C	CEDARVILLE MARINA	0
		HUSTEDS LANDING MARI	3.77928E+13
		MONEY ISLAND MARINA	1.45214E+13
		SUNDOG MARINA	5.58514E+13
		unable to find name	5.58514E+13
	D	GANDYS BEACH MARINA	1.45214E+13
	E	Double A Marina	3.87236E+12
		FORTESCUE STATE MARI	7.84712E+13
		Fortesque Pavalion	0
		HIGBEES MARINA	4.84045E+12
		Hook, Line and Sinke	0
		Triangle	0
	F	4-Star Marina s(lips	6.98142E+13
		Anchor Marina	5.51253E+13
		Boat World Marina	8.21015E+13
		Cox's Penny Hill Mar	7.55855E+12
		Driftwood Marina	1.77793E+13
		Haase Marina	1.29389E+13
		Long Reach	5.8737E+13
		Poppeyes Marina	6.57184E+13
		Port Norris	8.62904E+13
		Port Norris South	7.59578E+13
		Robinsons Marina	2.71065E+13
		Sail Loft	6.66493E+12
		Spring Garden Marina	2.67342E+13
Delaware Bay Tribs-Tidal	B	Double A Marina	3.87236E+12
		FORTESCUE STATE MARI	7.84712E+13
		Fortesque Pavalion	0
		HIGBEES MARINA	4.84045E+12
		Hook, Line and Sinke	0
		Triangle	0
Maurice River Estuary and Cove	-	4-Star Marina s(lips	6.98142E+13
		Anchor Marina	5.51253E+13
		Boat World Marina	8.21015E+13
		Cox's Penny Hill Mar	7.55855E+12
		Driftwood Marina	1.77793E+13
		Haase Marina	1.29389E+13

Waterbody	Subgroup	Marina Name	Load (cfu)
		Long Reach	5.8737E+13
		Poppeyes Marina	6.57184E+13
		Port Norris	8.62904E+13
		Port Norris South	7.59578E+13
		Robinsons Marina	2.71065E+13
		Sail Loft	6.66493E+12
		Spring Garden Marina	2.67342E+13
Nantuxent Creek Estuary	-	MONEY ISLAND MARINA	1.45214E+13
		SUNDOG MARINA	5.58514E+13
		unable to find name	5.58514E+13